

TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371

051009/0119

U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5)

Unassigned 09/284024

INTERNATIONAL APPLICATION NO.  
PCT/EP97/05890INTERNATIONAL FILING DATE  
October 24, 1997PRIORITY DATE CLAIMED  
November 2, 1996

## TITLE OF INVENTION

POLYAMIDE-BASED SAUSAGE SKIN WHICH CAN BE FILLED MANUALLY

## APPLICANT(S) FOR DO/EO/US

Ulrich DELIUS

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
  - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☒ has been transmitted by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. 371 (c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
  - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☒ have been transmitted by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☐ have not been made and will not be made.
8. ☒ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.  
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:

International Search Report

17. ☒ The following fees are submitted:**Basic National Fee (37 CFR 1.492(a)(1)-(5):**

Search Report has been prepared by the EPO or JPO ..... \$840.00

International preliminary examination fee paid to USPTO (37 CFR 1.482)

..... \$670.00

No international preliminary examination fee paid to USPTO (37 CFR 1.482)

but international search fee paid to USPTO (37 CFR 1.445(a)(2)) ..... \$760.00

Neither international preliminary examination fee (37 CFR 1.482) nor

international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... \$970.00

International preliminary examination fee paid to USPTO (37 CFR 1.482)

and all claims satisfied provisions of PCT Article 33(2)-(4) ..... \$96.00

**ENTER APPROPRIATE BASIC FEE AMOUNT =****CALCULATIONS**

PTO USE ONLY

840.00

\$ 840.00

Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30  
months from the earliest claimed priority date (37 CFR 1.492(e))

\$ 0.00

Claims	Number Filed	Number Extra	Rate
Total Claims	11 -20 =	0	X \$18.00
Independent Claims	1 -3 =	0	X \$78.00
Multiple dependent claim(s) (if applicable)			+ \$260.00

\$ 0.00

**TOTAL OF ABOVE CALCULATIONS =**

\$ 840.00

Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement  
must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).

\$

**SUBTOTAL =**

\$ 840.00

Processing fee of \$130.00 for furnishing English translation later the ☐ 20 ☐ 30  
months from the earliest claimed priority date (37 CFR 1.492(f)).

\$ 0.00

**TOTAL NATIONAL FEE =**

\$ 840.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be  
accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +

\$ 40.00

**TOTAL FEES ENCLOSED =**

\$ 880.00

Amount to be:  
refunded \$  
charged \$a. ☒ A check in the amount of \$880.00 to cover the above fees is enclosed.b. ☐ Please charge my Deposit Account No. 19-0741 in the amount of \$\_\_\_\_\_ to the above fees. A duplicate copy of this sheet  
is enclosed.c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to  
Deposit Account No. 19-0741. A duplicate copy of this sheet is enclosed.**NOTE:**Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive  
(37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Foley & Lardner  
3000 K Street, N.W., Suite 500  
P.O. Box 25696  
Washington, D.C. 20007-8696

SIGNATURE

Richard L. Schwaab

NAME

25,479

REGISTRATION NUMBER

09/284024

510 Rec'd PCT/PTO 06 APR 1999

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Attorney Docket No. 051009/0119

In re patent application of

Ulrich DELIUS

Serial No.: Unassigned

Filed: April 6, 1999

For: POLYAMIDE-BASED SAUSAGE SKIN WHICH CAN BE FILLED  
MANUALLY

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

Prior to examination of the above-identified application, Applicant respectfully requests that the following amendments be entered into the application:

IN THE CLAIMS:

Claim 3, line 1, delete "or 2".

Claim 4, line 1, delete "or 2".

Claim 5, lines 1-2, delete "one or more of claims 1 to 4" and insert "--claim 1--".

Claim 7, line 1, delete "or 6".

Claim 8, lines 1-2, delete "one or more of claims 1 to 7" and insert "--claim 1--".

Claim 9, line 1, delete "or 2".

Claim 10, line 1, delete "or 2".

Claim 11, line 1, delete "or 2".

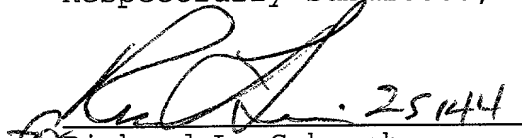
Attorney Docket No.: 051009/0119  
Applicant: Ulrich DELIUS

REMARKS

Applicant respectfully requests that the foregoing amendments to Claims 3-5 and 7-11 be entered in order to avoid this application incurring a surcharge for the presence of one or more multiple dependent claims.

Respectfully submitted,

April 6, 1999

  
Richard L. Schwaab  
Reg. No. 25,479

FOLEY & LARDNER  
3000 K Street, N.W.  
Suite 500  
Washington, D.C. 20007-5109  
Tel: (202) 672-5300

510 PCT/PTO 06 APR 1999

Polyamide-based sausage skin which can be filled manually

5 The present invention relates to a polyamide-based sausage casing. It is contemplated, in particular, for sausage production on a relatively small scale in which stuffing is performed not automatically, but manually. The casing is especially suitable for cooked-meat sausages and scalded-emulsion sausages.

10 Fiber-reinforced cellulose casings which are produced by the viscose process and are provided with a water-impermeable inner coating have the largest share in the production of cooked-meat sausages and scalded-emulsion sausages. They are followed in second place by the casings made of thermoplastics, in particular of polyamide or vinylidene chloride copolymers. For sausage production on an artisanal scale, the internally-coated fiber-reinforced cellulose casings are considerably better suited than the thermoplastic casings.

20 Cooked-meat sausages and scalded-emulsion sausages are, after stuffing, scalded in water or steam at about 80°C, occasionally also at from 110 to 130°C. In the course of this the volume of the sausage-meat emulsion increases. On cooling it then markedly decreases again. The sausage casing must adapt itself to the changing volume of the sausage-meat emulsion. In particular, the sausage casing is to contract on cooling to the extent that no wrinkles are formed. This is because sausage having a wrinkled casing is generally regarded as "no longer fresh". Furthermore, the casing should have sufficient tension that no liquid collects under it after the scalding. A "gel deposit" of this type between casing and emulsion is likewise considered a quality defect.

Said internally-coated cellulose casings are usually softened prior to stuffing. In this process, the highly hygroscopic cellulose is saturated with water. The water absorption is generally from 110 to 140% by weight. At the same time the casing swells and becomes highly supple. In this state, it is stuffed with the emulsion. After the scalding and cooling, the sausage is dried. In the course of this, the casing releases again the majority of the absorbed water. However, because of the impermeable inner coating, virtually no moisture can escape from the sausage-meat emulsion. During the drying, the cellulose layer contracts greatly, so that the casing tightly encloses the cooled sausage-meat emulsion. Wrinkles and gel deposit are thus prevented, even if the emulsion - as is usual with manual stuffing - was stuffed under no external pressure or at only a low pressure.

As regards their service properties, the internally coated cellulose casings are ideal for manual stuffing. However, a disadvantage with these casings is the complex and expensive production by the viscose process. In this process, a cellulose xanthogenate solution is firstly applied to the fiber reinforcement which has been preshaped to form a tube. The cellulose xanthogenate is then precipitated in dilute sulfuric acid and regenerated to form cellulose hydrate. After washing and drying the casing, a polymer dispersion is applied to its inside, which polymer dispersion then gives the water-impermeable coating.

In contrast, cooked-meat sausage casings and scalded-emulsion sausage casings may be produced much more simply and inexpensively by extrusion blow-moulding of thermoplastics. Casings of biaxially stretched polyamide have achieved some importance here. Thus, DE-A 28 50 182

Arake 34

(= GB-A 2 035 198) describes a single-layer biaxially stretched casing of an aliphatic polyamide whose glass transition point in the dry state is at least 48°C and which may be decreased after water absorption to at least 3°C, preferably to -5°C. Polyamides which are specifically disclosed are nylon 6 (= polycaprolactam), nylon 7, nylon 6,6 (= polyamide of hexamethylenediamine and adipic acid), nylon 6,10 (= polyamide of hexamethylenediamine and sebacic acid). According to DE-A 28 50 181, the casing additionally comprises an ionomer resin, a modified ethylene-vinyl acetate copolymer and/or a quaternary copolymer containing units of ethylene, butylene, an aliphatic ethylenically unsaturated (C<sub>3</sub>-C<sub>5</sub>)carboxylic acid and an ester of this carboxylic acid with a (C<sub>1</sub>-C<sub>8</sub>)alkanol. This casing, after the initial cutting of the sausage, shows a reduced tendency to tear propagation. The polyamide casing according to DE-A 32 27 945 (= US-A 4 560 520 and 4 601 929) is said to have the same advantage.

EP-A 0 065 278 discloses a single- or multilayer, shrinkable flat film in which the layer or at least one layer consists of polyamide. The polyamide layer comprises a linear aliphatic (co-)polyamide and a partially aromatic (co-)polyamide. The linear aliphatic (co-)polyamide can be partially or completely replaced by an elastomeric component, such as polybutadiene, polyurethane rubber or nitrile rubber. The film is additionally stretched, but not thermoset, since it is to have a high shrinkability and high shrinkage force. These properties are caused by the special polymer combination in the polyamide layer.

In order that the finished cooked-meat sausages and scalded-emulsion sausages lose as little weight as possible during storage, a permeability to water or water vapor as low as possible is also wanted for the casings made of thermoplastics. However, many polyamides can absorb up to 10% by weight of water. Pure polyamide casings are therefore less suitable. In order to make up for this disadvantage, multilayer casings have been developed which additionally comprise (at least) one

layer of a water-vapor-impermeable polymer. Thus, the biaxially stretched casing according to EP-A 573 306 consists of a middle polyamide layer and an inner layer and an outer layer of a water-vapor-barrier polymer, eg. a polyolefin. DE-A 40 17 046 likewise discloses a three-layer biaxially stretched and thermoset casing. Here, the outer layer consists of aliphatic polyamide and/or copolyamide, the middle layer consists of polyolefin and an adhesion-promoting component and the inner layer consists of aliphatic and/or partially aromatic (co-)polyamide.

After heating to temperatures of about 80°C or above, as are attained on scalding the sausage, the casings begin to shrink. Owing to this thermal shrink, the circumference of the casing generally decreases by from 5 to 20%. The extent of the contraction also depends here on the conditions in the preceding thermosetting. Usually, during the thermosetting a transverse shrinkage of the tube of up to 40% has already taken place. Simultaneously, the diameter of the tube becomes more uniform. On scalding the sausage, the thermal shrinkage begins virtually immediately. This leads to the tension of the casing being greatest at the beginning of the



only a relatively low residual elasticity.

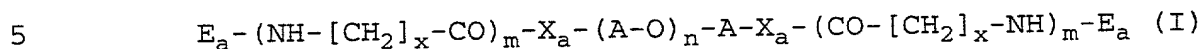
In sausage production on an industrial scale, this problem is solved by stuffing the emulsion under high pressure. A stuffing pressure of from 20 to 40 kPa is usual, depending on the caliber of the sausage casing. However, specially constructed stuffing machines are necessary for this. In this manner, a first (partially) elastic extension of the casing is achieved. The elastic force resulting in the course of this is, as is also the thermal shrinkage force, partially diminished during the scalding. The remaining force is then generally just sufficient to ensure tight and wrinkle-free fitting of the casing.

However, without special stuffing machines, a high stuffing pressure cannot be achieved. Manually stuffed polyamide casings are therefore, after the scalding and cooling, generally wrinkled and less attractive. Therefore, in the artisanal sector, the internally-coated cellulose casings described at the outset continue to be used.

The object was therefore to develop a casing for cooked-meat sausages and scalded-emulsion sausages which can be produced by extrusion blow-molding from thermo-plastics and can be tightly filled without wrinkling even if the emulsion was stuffed without external pressure or at a low pressure, that is by hand and without using special stuffing machines.

The object is achieved by a biaxially stretched and thermoset, tubular, seamless, single-layer or multilayer food casing in which the layer or, in the case of multilayer casings, at least one of the layers comprises

a block copolymer containing "hard" aliphatic polyamide blocks and "soft" aliphatic polyether blocks, which block copolymer corresponds to one of the formulae I to III:



where

A is an alkanediyl radical of the formula  $-CH_2-CH_2-$   
(= ethane-1,2-diyl),

10  $-CH_2-CH(CH_3)-$  (= propane-1,2-diyl) or  
 $-(CH_2)_4-$  (= butane-1,4-diyl),

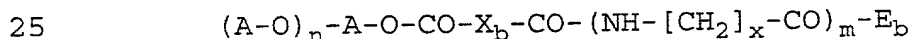
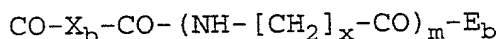
$X_a$  is  $-O-$  or  $-NH-$ ,

$E_a$  is H,  $(C_2-C_8)$ alkanoyl, benzoyl or phenylacetyl,  
CO-N $([CH_2]_{x-1}-CH_3)-CO-(C_1-C_4)$ alkyl,  
15 CO-N $([CH_2]_{x-1}-CH_3)-CO-C_6H_5$  or  
CO-N $([CH_2]_{x-1}-CH_3)-CO-CH_2-C_6H_5$ ,

x is an integer from 5 to 11,

m is an integer from 30 to 200 and

n is an integer from 4 to 60;



where

$X_b$  is an alkanediyl radical of the formula  $-[CH_2]_z-$ ,  
where z is an integer from 4 to 10,

30 *meta*- or *para*-phenylene,

$-NH-(C_1-C_6)$ alkyl-NH-,

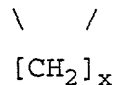
$-NH-C_6H_3-(CH_3)-NH-$ ,

$>N-[CH_2]_{x-1}-CH_3$ ,  $-[CH_2]_z-CO-N([CH_2]_{x-1}-CH_3)-$  or

$-C_6H_4-CO-N([CH_2]_{x-1}-CH_3)-$ ,

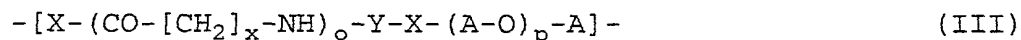
35 where  $C_6H_4$  is *meta*- or *para*-phenylene,

$E_b$  is -OH, -O-(C<sub>1</sub>-C<sub>7</sub>)alkyl, -O-phenyl or -N—C=O



and

5 A, m and n have the meanings given above;



where

10 Y is -CO-, -CO-[CH<sub>2</sub>]<sub>z</sub>-CO- or -CO-C<sub>6</sub>H<sub>4</sub>-CO-,  
 where C<sub>6</sub>H<sub>4</sub> is *meta*- or *para*-phenylene, or is  
 -CO-N([CH<sub>2</sub>]<sub>x-1</sub>-CH<sub>3</sub>)-CO-,  
 -CO-N([CH<sub>2</sub>]<sub>x-1</sub>-CH<sub>3</sub>)-CO-[CH<sub>2</sub>]<sub>z</sub>-CO-N([CH<sub>2</sub>]<sub>x-1</sub>-CH<sub>3</sub>)-CO- or  
 -CO-N([CH<sub>2</sub>]<sub>x-1</sub>-CH<sub>3</sub>)-CO-C<sub>6</sub>H<sub>4</sub>-CO-N([CH<sub>2</sub>]<sub>x-1</sub>-CH<sub>3</sub>)-CO-,  
 15 where C<sub>6</sub>H<sub>4</sub> has the meanings specified,  
 o is an integer from 10 to 150 and  
 p is an integer from 4 to 100 and  
 A, x and z have the meanings given above.

20 The "hard" polyamide blocks in the block copolymer of the  
 formulae I to III generally have a glass transition  
 temperature  $T_g$  of from 20 to 80°C, while the "soft"  
 polyether blocks have a  $T_g$  of from -100 to -20°C. The  
 variable X is preferably 5, ie. the polyamide blocks are  
 25 preferably polycaprolactam blocks, while A is preferably  
 ethane-1,2-diyl or butane-1,4-diyl, ie. the polyether  
 blocks are preferably poly(ethylene glycol) or  
 poly(butylene glycol) blocks. The block copolymer of  
 formula III in which the hard and soft blocks occur in  
 30 alternating sequence generally has an average molecular  
 weight  $M_w$  of from 20,000 to 70,000.

Of the block copolymers of the formulae I and II,  
 preference is given to those where n = from 40 to 100 and  
 35 n = from 10 to 40. Of the block copolymers of the formula

III, again preference is given to those where o = from 10 to 60 and p = from 20 to 40.

Particular preference is given to block copolymers of the formula I where  $X_a = -NH-$  and block copolymers of the formula III in which  $X = -O-$  and  $Y = -CO-[CH_2]_4-CO-$  or  $-CO-[CH_2]_{10}-CO-$ .

The block copolymers of the formulae I, II and III are known as such and are described in US-A 4 501 861.

In a particular embodiment, this layer further contains at least one aliphatic and/or partially aromatic (co-)polyamide mixed with the block copolymers. Preferred (co-)polyamides of this type are nylon 6, nylon 6/6,6 (= copolyamide of  $\epsilon$ -caprolactam, hexamethylenediamine and adipic acid), nylon 6/12 (= copolyamide of  $\epsilon$ -caprolactam and  $\omega$ -laurolactam), nylon 12 (= poly( $\omega$ -laurolactam) and nylon 6I/6T (= copolyamide of hexamethylenediamine, isophthalic acid and terephthalic acid). The content of the additional polymers in this layer is up to 85% by weight, based on the total weight of the layer.

The layer having the block copolymers of the formulae I, II and/or III can additionally be colored by the addition of inorganic or organic pigments. Finally, still further additives may be present, in particular antiblock agents and compositions which improve the processing properties.

The food casing according to the invention is produced by extrusion blow-molding. Corresponding processes are familiar per se to those skilled in the art. Generally, in these processes, the polymer (blend) is firstly plasticized to form a homogeneous melt and then extruded through a heated ring die. In this manner, a seamless

casing is obtained. The relatively thick tube obtained in the extrusion is firstly rapidly cooled, in order to obtain the polymers in the amorphous state. The tube is then heated to the temperature required for stretching and is stretched by blow-molding. In this process the tube is expanded by the pressure of an internal gas (usually air). The stretched tube is then partially thermoset, so that a residual shrinkage in the range of from 5 to 20% at 80°C remains. In the course of this, the stretching ratio decreases slightly. The area stretching ratio of the thermoset casing is generally about from 6 to 10.

A casing having somewhat less favorable shrinkage properties and slightly decreased strength is obtained if the tube is blow-molded immediately after leaving the ring die and is then likewise (partially) thermoset. After cooling, the casings are usually flattened and rolled up.

For special applications, eg. when a casing having elevated water-vapor-barrier properties is wanted, multilayer casings are advantageous. The additional layers preferably consist of polyamides (eg. nylon 6) or polyolefins (eg. polyethylene or polypropylene). The polyolefins in this case can also bear adhesion-promoting functional groups. Furthermore, the additional layers can consist of (co-)polymers containing units of ethylenically unsaturated monomers (eg. vinyl acetate, vinyl alcohol or (meth)acrylic acid, of vinylidene chloride copolymers or acrylonitrile copolymers, of ionomer resins or mixtures of said (co)polymers.

In the case of the two-layer casing according to the present invention, the additional layer is preferably on

the inside. If the casing according to the invention has three layers, the outer layer preferably comprises the block copolymers of the formulae I, II and/or III. The multilayer casing according to the invention usually comprises no more than 5 layers.

The multilayer casings are generally produced by coextrusion. The coextrusion dies, with increasing number of the layers to be extruded, become technically more and more complex and costly, which limits the number of layers. Blow-molding and (partial) thermosetting then follow, as described above.

The casing according to the invention exhibits a high shrinkage under the conditions which are generally reached in the scalding of cooked-meat sausage and scalded-emulsion sausage. The casing has roughly "rubber-like" resilience properties. The sausages produced therewith - without the use of stuffing machines - are, after scalding and cooling, tightly-filled and wrinkle-free.

In the examples below, pw is parts by weight. Percentages, unless stated otherwise, are percentages by weight.

Example 1:

A blend of

70 pw of nylon 6 (the relative viscosity of a 1% strength solution of the polyamide in 96% strength sulfuric acid was 4) and  
30 pw of a block copolymer containing poly(propylene glycol) blocks and polycaprolactam blocks (<sup>®</sup>Grilon ELX 2112 from Ems-Chemie AG), whose melting point

was 209°C (determined by DSC = differential scanning calorimetry)

was plastified in a single-screw extruder at 240°C to form a homogeneous melt and extruded through a ring die to form a tube having a diameter of 18 mm. The tube was cooled rapidly, then brought to the temperature required for stretching, stretched by blow-molding and finally thermoset, in which case the stretching ratio decreased by 5% in the transverse direction, while it remained unchanged in the longitudinal direction. The area stretching ratio was 8.7. The finished casing had a diameter of 60 mm.

Example 2:

A blend of

50 pw of nylon 6 (as in Example 1),  
30 pw of a block copolymer of poly(butane-1,4-diol) blocks and polylauro lactam blocks (®Pebax 5533 SN01 from Elf Atochem S.A.), which had a melt flow index of 5 g/10 min at 235°C and 1 kg load, and  
20 pw of nylon 6/12 (®Grilon CF6S from Ems Chemie AG), which had a melt flow index of 50 g/10 min at 190°C and 10 kg load,

was, as described in Example 1, extruded to form a tube having a diameter of 19 mm, stretched and thermoset. The area stretching ratio was 8.3. The finished sausage casing again had a diameter of 60 mm.

Example 3:

To produce a three-layer sausage casing, the following blends were prepared:

## Blend A:

90 pw of nylon 6 (as in example 1) and  
10 pw of the block copolymer also used in Example 1;

## Blend B:

70 pw of LDPE (low density polyethylene), which had a  
melt flow index of 0.2 g/10 min at 190°C and  
2.16 kg load (®Lupolen 2441D from BASF AG), and  
30 pw of LLDPE (linear low density polyethylene) which,  
by modification with maleic anhydride, had been  
finished to be adhesion-promoting with respect to  
polyamide and had a melt flow index of 3 g/10 min  
at 190°C and 2.16 kg load (®Escor CTR 2000 from  
Exxon);

## Blend C:

85 pw of nylon 6 (as in Example 1) and  
15 pw of amorphous nylon 6I/6T, which had a melt flow  
index of 90 g/10 min at 275°C and 10 kg load  
(®Selar PA 3426 from Du Pont de Nemours Inc.).

The blends were plasticized to form homogeneous melts in  
three single-screw extruders at 240°C in each case, then  
brought together in a three-layer ring die and coextruded  
to form a three-layer tube having a diameter of 29 mm.  
The tube was then, as described, stretched and thermoset.  
During thermosetting, the transverse stretching ratio  
decreased by 20%. The area stretching ratio was 8.7 after  
this. The diameter of the finished sausage casing was  
80 mm. Total wall thickness of the casing was 54 µm. In  
this, the outer layer (from blend A) had a thickness of  
34 µm, the middle layer (from blend B) of 16 µm and the  
inner layer (from blend C) of 4 µm.



Example 4:

Example 3 was repeated with the single change that, instead of the blend A used there, a blend A of

70 pw of nylon 6 (as in Example 1) and  
30 pw of the block copolymer according to Example 1  
was used.

As described in Example 3, a three-layer tube having a diameter of 28 mm was coextruded, stretched and thermoset. The area stretching ratio was 9. The diameter of the finished casing was 80 mm. At a total casing wall thickness of 51  $\mu\text{m}$ , the outer layer (from blend A) had a thickness of 30  $\mu\text{m}$ , the middle layer (from blend B) had a thickness of 15  $\mu\text{m}$  and the inner layer (from blend C) had a thickness of 6  $\mu\text{m}$ .

Example 5:

Example 3 was repeated with the single change that, instead of the blend A used there, a blend A of

65 pw of nylon 6 (as in Example 1),  
20 pw of the block copolymer also used in Example 2 and  
15 pw of nylon 6/12 (as in Example 2)

was used. The diameter of the finished casing was 80 mm, its area stretching ratio was 7.9. At a total casing wall thickness of 56  $\mu\text{m}$ , the outer layer (from blend A) had a thickness of 35  $\mu\text{m}$ , the middle layer (from blend B) had a thickness of 15  $\mu\text{m}$  and the inner layer (from blend C) had a thickness of 6  $\mu\text{m}$ .

Example 6:

Example 3 was repeated with the single change that

instead of the blend A used there, a blend A of

50 pw of nylon 6 (as in Example 1),  
30 pw of the block copolymer also used in Example 2 and  
20 pw of nylon 6/12 (as in Example 2)

was used. The diameter of the finished casing was 80 mm.  
The area stretching ratio was 9.0. At a total casing wall  
thickness of 52  $\mu\text{m}$ , the outer layer (from blend A) had a  
thickness of 32  $\mu\text{m}$ , the middle layer (from blend B) had  
a thickness of 14  $\mu\text{m}$  and the inner layer (from blend C)  
had a thickness of 6  $\mu\text{m}$ .

Comparison Example 1:

In accordance with DE-A 28 50 182, the nylon 6 also used  
in Example 1 was extruded by the process specified there  
to form a tube having a diameter of 19 mm which was then  
stretched and thermoset as described. The area stretching  
ratio of the finished casing was 8.3, and its diameter  
was 60 mm.

Comparison Example 2:

In accordance with DE-A 40 17 046,

Component A: nylon 6 (as in Example 1),  
Blend B: identical to blend B in Example 3 and  
Blend C: identical to blend C in Example 3

were, as described there, coextruded to form a tube  
having a diameter of 29 mm, stretched and thermoset.  
During the thermosetting, the transverse stretching ratio  
decreased by 20%. The area stretching ratio of the  
finished casing was 7.9, and its diameter was 52 mm. At  
a total casing wall thickness of 52  $\mu\text{m}$ , the outer layer

(from component A) had a thickness of 31  $\mu\text{m}$ , the middle layer (from blend B) had a thickness of 13  $\mu\text{m}$  and the inner layer (from blend C) had a thickness of 8  $\mu\text{m}$ .

5 The measurements in the table below show the superiority of the casing according to the invention in comparison with those known from the prior art. In the table:

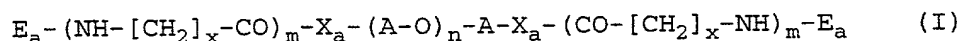
- 10 1) denotes measured as specified in DIN 53 455 on a 15 mm wide strip, which was treated with water for 30 min, at a clamping distance of 50 mm;
- 15 2) designates the tensile stress which must be applied in the test as specified in DIN 53 455 to extend by 5% the 15 mm wide strip, which was treated with water for 30 min, at the clamping distance of 50 mm and a rate of elongation of 50 mm/min;
- 20 3) denotes the percentage increase of the outer circumference of tube sections, which were treated in advance with water for 30 min and have then been inflated to achieve the specified internal pressure;
- 25 4) after storage for 15 min in water at 80°C;
- 30 5) the casing was exposed on one side to air having a relative humidity (RH) of 85% at 20°C. The water vapor permeability was measured as specified in DIN 53 122.
- 35 6) denotes subjective evaluation of a casing which was treated with water for 30 min. The figures denote:  
1 = extremely soft; 2 = very soft; 3 = soft and  
4 = medium.

- 5 7) The casing was stuffed manually with fine-grained scalded-emulsion sausage meat emulsion at a constant low stuffing pressure and closed with metal clips. The sausages were then cooked in a heating cabinet for 60 min at 78°C and 100% RH. After cooling to 7°C, appearance and consistency were evaluated.

Ex- ample	Film thick- ness	Ultimate tensile stress		$\sigma_5$ trans- verse	Transverse expansion		Shrink- age trans- verse	Water vapor perme- ability	Flexi- bility	"Fit" of the casing
No.	in $\mu\text{m}$	$\text{N/mm}^2$		$\text{N/mm}^2$	in % at		in %	$\text{g/m}^2\cdot\text{day}$	6)	7)
		longi- tudinal	trans- verse		15kPa	25kPa				
1	34	137	135	11.3	3.6	7.0	10	37.4	2	wrinkle-free tightly filled
2	36	96	89	8.2	3.4	6.5	13	31.0	1	wrinkle-free tightly filled
3	54	147	143	14.0	2.8	5.4	8	3.6	2	wrinkle-free tightly filled
4	51	113	111	11.5	4.1	8.0	8	3.9	1	wrinkle-free tightly filled
5	56	94	96	11.9	3.3	6.2	9	4.0	2	wrinkle-free tightly filled
6	52	92	88	8.0	3.7	7.2	8	4.2	1	wrinkle-free tightly filled
C1	35	133	177	15.1	2.3	4.8	10	26.2	4	wrinkled
C2	52	110	109	14.6	2.4	5.1	8	3.8	3	slightly wrinkled

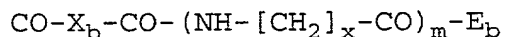
Patent Claims

1. A biaxially stretched and thermoset, tubular, seamless, single-layer or multiple-layer food casing in which the layer or, in the case of multiple-layer casings, at least one of the layers comprises a block copolymer containing "hard" aliphatic polyamide blocks and "soft" aliphatic polyether blocks, which block copolymer corresponds to one of the formulae I to III



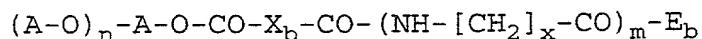
where

- A is an alkanediyl radical of the formula  
 $-CH_2-CH_2-$  (= ethane-1,2-diyl),  
 $-CH_2-CH(CH_3)-$  (= propane-1,2-diyl) or  
 $-(CH_2)_4-$  (= butane-1,4-diyl),  
 $X_a$  is  $-O-$  or  $-NH-$ ,  
 $E_a$  is H,  $(C_2-C_8)$ alkanoyl, benzoyl or phenylacetyl,  
 $CO-N([CH_2]_{x-1}-CH_3)-CO-(C_1-C_4)$ alkyl,  
 $CO-N([CH_2]_{x-1}-CH_3)-CO-C_6H_5$  or  
 $CO-N([CH_2]_{x-1}-CH_3)-CO-CH_2-C_6H_5$ ,  
 $x$  is an integer from 5 to 11,  
 $m$  is an integer from 30 to 200 and  
 $n$  is an integer from 4 to 60;



$$|$$

$$O$$

$$|$$


where

- $X_b$  is an alkanediyl radical of the formula

$-\text{[CH}_2\text{]}_z-$ ,

where  $z$  is an integer from 4 to 10,

*meta*- or *para*-phenylene,

$-\text{NH}-(\text{C}_1-\text{C}_6)\text{alkyl}-\text{NH}-$ ,

$-\text{NH}-\text{C}_6\text{H}_3-(\text{CH}_3)-\text{NH}-$ ,

$>\text{N}-\text{[CH}_2\text{]}_{x-1}-\text{CH}_3$ ,  $-\text{[CH}_2\text{]}_z-\text{CO}-\text{N}(\text{[CH}_2\text{]}_{x-1}-\text{CH}_3)-$  or

$-\text{C}_6\text{H}_4-\text{CO}-\text{N}(\text{[CH}_2\text{]}_{x-1}-\text{CH}_3)-$ ,

where  $\text{C}_6\text{H}_4$  is *meta*- or *para*-phenylene,

$\text{E}_b$  is  $-\text{OH}$ ,  $-\text{O}-(\text{C}_1-\text{C}_7)\text{alkyl}$ ,  $-\text{O}$ -phenyl or  $-\text{N}=\text{C}=\text{O}$

\ /  
[CH<sub>2</sub>]<sub>x</sub>

and

$A$ ,  $m$  and  $n$  have the meanings given above;

$-\text{[X}-(\text{CO}-\text{[CH}_2\text{]}_x-\text{NH})_o-\text{Y}-\text{X}-(\text{A}-\text{O})_p-\text{A}]-$  (III)

where

$Y$  is  $-\text{CO}-$ ,  $-\text{CO}-\text{[CH}_2\text{]}_z-\text{CO}-$  or  $-\text{CO}-\text{C}_6\text{H}_4-\text{CO}-$ ,

where  $\text{C}_6\text{H}_4$  is *meta*- or *para*-phenylene, or is

$-\text{CO}-\text{N}(\text{[CH}_2\text{]}_{x-1}-\text{CH}_3)-\text{CO}-$ ,

$-\text{CO}-\text{N}(\text{[CH}_2\text{]}_{x-1}-\text{CH}_3)-\text{CO}-\text{[CH}_2\text{]}_z-\text{CO}-\text{N}(\text{[CH}_2\text{]}_{x-1}-\text{CH}_3)-$   
 $\text{CO}-$  or

$-\text{CO}-\text{N}(\text{[CH}_2\text{]}_{x-1}-\text{CH}_3)-\text{CO}-\text{C}_6\text{H}_4-\text{CO}-\text{N}(\text{[CH}_2\text{]}_{x-1}-\text{CH}_3)-$   
 $\text{CO}-$ ,

where  $\text{C}_6\text{H}_4$  has the meanings specified,

$o$  is an integer from 10 to 150 and

$p$  is an integer from 4 to 100 and

$A$ ,  $x$  and  $z$  have the meanings given above.

2. The food casing as claimed in claim 1, wherein the hard polyamide blocks in the block copolymers of the formulae I to III have a glass transition temperature ( $T_g$ ) of from 20 to 80°C and the soft polyether blocks have a  $T_g$  of from -100 to -20°C.

3. The food casing as claimed in claim 1 or 2, wherein the polyamide blocks are polycaprolactam blocks and the polyether blocks are poly(ethylene glycol) or poly(butylene glycol) blocks.
4. The food casing as claimed in claim 1 or 2, wherein, in the block copolymers of the formulae I and II, m is from 40 to 100 and n is from 10 to 40 and, in the block copolymers of the formula III, o is from 10 to 60 and p is from 20 to 40.
5. The food casing as claimed in one or more of claims 1 to 4, wherein the layer comprises at least one aliphatic and/or partially aromatic (co-)polyamide, mixed with the remaining constituents.
6. The food casing as claimed in claim 5, wherein the (co-)polyamide is nylon 6, nylon 6/6,6, nylon 6/12, nylon 12 or nylon 6I/6T.
7. The food casing as claimed in claim 5 or 6, wherein the proportion of the (co-)polyamide is up to 85% by weight, based on the total weight of the layer.
8. The food casing as claimed in one or more of claims 1 to 7, wherein the layer comprises inorganic or organic pigments.
9. The food casing as claimed in claim 1 or 2, which consists of multiple layers and the further layers consist of polyamides or polyolefins.
10. The food casing as claimed in claim 1 or 2, which has been stretched by blow-molding and extruded through a heated ring die.



11. The food casing as claimed in claim 1 or 2, which has an area stretching ratio of from about 6 to 10.

**DECLARATION AND POWER OF ATTORNEY**

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

**POLYAMIDE-BASED SAUSAGE SKIN WHICH CAN BE FILLED MANUALLY**

the specification of which is attached hereto unless the following box is checked:

☐ was filed on **October 24, 1997** as ~~United States Application Number~~ or PCT International Application Number **PCT/EP97/05890** and was amended on (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is known by me to be material to patentability as defined in Title 37, Code of Federal Regulations § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 (a)-(d) or § 365 (b) of any foreign application(s) for patent or inventor's certificate, or § 365 (a) of any PCT International Application which designated at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed:

**PRIOR FOREIGN APPLICATION(S)**

NUMBER	COUNTRY	DAY/MONTH/YEAR FILED	PRIORITY CLAIMED
196 45 276.7	Federal Republic of Germany	2/November/1996	YES

I hereby claim the benefit under Title 35, United States Code §119 (e) of any United States provisional application(s) listed below:

APPLICATION NUMBER	FILING DATE

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s), or § 365 (c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is known by me to be material to patentability as defined in Title 37, Code of Federal Regulations § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

APPLICATION SERIAL NO.	FILING DATE	STATUS: PATENTED, PENDING, ABANDONED

I hereby appoint as my attorneys, with full powers of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: Stephen A. Bent, Reg. No. 29,768; David A. Blumenthal, Reg. No. 26,257; William T. Ellis, Reg. No. 26,874; John J. Feldhaus, Reg. No. 28,822; Patricia D. Granados, Reg. No. 25,735; John P. Isacson, Reg. No. 33,715; Michael D. Kaminski, Reg. No. 32,904; Kenneth E. Krosin, Reg. No. 25,735; Eugene M. Lee, Reg. No. 32,039; Richard Linn, Reg. No. 25,144; Peter G. Mack, Reg. No. 26,001; Brian J. McNamara, Reg. No. 32,789; Sybil Meloy, Reg. No. 22,749; George E. Quillin, Reg. No. 32,792; Colin G. Sandercock, Reg. No. 31,298; Bernhard D. Saxe, Reg. No. 28,665; Charles F. Schill, Reg. No. 27,590; Richard L. Schwaab, Reg. No. 25,479; Arthur Schwartz, Reg. No. 22,115; Harold C. Wegner, Reg. No. 25,258.

Address all correspondence to **Foley & Lardner**, 3000 K Street, N.W., Suite 500, P. O. Box 25696, Washington, D.C. 20007-8696.  
Address telephone communications to **Richard L. Schwaab** at (202)672-5300.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this application or any patent issued thereon.

Full name of First or Sole Inventor <i>Ulrich Delius</i> <u>Ulrich DELIUS</u>	Signature of First or Sole Inventor	Date <i>1 April 1999</i>
Residence Address <i>Frankfurt</i> <u>Federal Republic of Germany</u>	Country of Citizenship <i>Federal Republic of Germany</i> <i>DEX</i>	
Post Office Address <i>Geisenheimer Strasse 88, D-60529 Frankfurt, Federal Republic of Germany</i>		

**Office Address of the Inventor:**

Kalle Nalo GmbH & Co. KG  
Rheingastrasse 190, Industriepark Kalle-Albert  
D-65203 Wiesbaden, Federal Republic of Germany